Complete Summary

GUIDELINE TITLE

Guidelines for the field management of combat-related head trauma. Treatment: airway, ventilation, and oxygenation.

BIBLIOGRAPHIC SOURCE(S)

Knuth T, Letarte PB, Ling G, Moores LE, Rhee P, Tauber D, Trask A. Guidelines for the field management of combat-related head trauma. Treatment: airway, ventilation, and oxygenation. New York (NY): Brain Trauma Foundation; 2005. 10 p. [26 references]

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Combat-related traumatic brain injury

GUIDELINE CATEGORY

Evaluation
Management

CLINICAL SPECIALTY

Emergency Medicine
Neurological Surgery
Neurology

INTENDED USERS

Emergency Medical Technicians/Paramedics
Physicians

GUIDELINE OBJECTIVE(S)

- To provide dispassionate analysis of the known benefits and risks of therapies available to the brain injured patient in the field
- To be a resource and a tool for the combat medic, physician, commanding officer, and logistician who must then make the tough "on the ground" therapeutic, tactical, and logistical decisions that will ultimately result in optimum care for the injured combatant
- To prevent or reduce hypoxia or hyper- and hypocarbia in the head injured patient

TARGET POPULATION

Combat personnel who sustain traumatic brain injury in the field

INTERVENTIONS AND PRACTICES CONSIDERED

Monitoring/Assessment

1. Oxygen saturation measurements
2. Carbon dioxide partial pressure (pCO_2) measurement
3. End-tidal carbon dioxide ($EtCO_2$) measurement
4. Monitoring of endotracheal tube (ET) placement (chest radiography, self-inflating bulb (SIB) device, Upsherscope®), $EtCO_2$ measurement

Intervention/Treatment

1. Airway management using ET intubation using direct laryngoscopy (other options include Intubating Laryngeal Mask Airway [ILMA®], Combitube®, and Fiberoptic Intubation device [FI]
2. Hyperventilation for patients showing signs of cerebral herniation

Note: The routine or prophylactic use of hyperventilation was considered but not recommended.

MAJOR OUTCOMES CONSIDERED

- Correlation between Glasgow Coma Score and need for intubation
- Time to successful intubation
- Complication rate, including number of hypoxic events, aspiration, and pneumothorax
- Morbidity and mortality

- Relationship of tactical scenarios and provider skills to outcome

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

General Search Strategy

In order to create an evidence-based document relevant to the field treatment of brain injury, the literature was searched for each topic for publications on brain injury that pertained to the prehospital or austere environment. From the comprehensive literature searches, articles were selected which were relevant to the field management of traumatic brain injury (TBI) and utilized human data. Articles with outcomes related to morbidity and mortality were preferred. In establishing a literature base for recommendations, the guideline authors generally only include publications that involve human subjects. However, in these Guidelines, they have included some publications that involve training with mannequins given that such training is an accepted practice in assessing competency for emergency medical technician (EMT) certification. Additional studies were, in general, referenced only as a part of background discussion. The prehospital literature was heavily utilized; military literature was used where it was available.

Specific Strategy for This Topic

A literature search from 1970 to 2005 was conducted using the terms "airway" or "oxygenation" or "intubation" or "advanced airway," and "prehospital care" or "EMS" or "emergency medical services," and "traumatic head injury" or "traumatic brain injury" or "TBI." Reference to the *Guidelines for Prehospital Management of Traumatic Brain Injury* chapter "Treatment: Airway, Ventilation, and Oxygenation" was also made. That process of literature review produced 187 references, 26 of which were directly relevant to outcome analysis and clinical orientation.

NUMBER OF SOURCE DOCUMENTS

10

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Classification of Evidence

Class I: Evidence from good quality, randomized, controlled clinical trials (RCT)

Class II: Evidence from moderate or poor quality RCT, good quality cohort, or good quality case-control studies

Class III: Evidence from moderate or poor quality cohort; moderate or poor quality case control; or case series, databases, or registries

Additional detail on quality criteria for each category is available in the original guideline document.

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

The Guidelines follow the recommendations of the Institute of Medicine (IOM) Committee to Advise the Public Health Service on Clinical Practice Guidelines outlined below:

1. There should be a link between the available evidence and the recommendations.
2. Empirical evidence should take precedence over expert judgment in the development of guidelines.
3. The available scientific literature should be searched using appropriate and comprehensive search terminology.
4. A thorough review of the scientific literature should precede guideline development.
5. The evidence should be evaluated and weighted, depending on the scientific validity of the methodology used to generate the evidence.
6. The strength of the evidence should be reflected in the strength of the recommendations, reflecting scientific certainty (or lack thereof).
7. Expert judgment should be used to evaluate the quality of the literature and to formulate guidelines when the evidence is weak or nonexistent.
8. Guideline development should be a multidisciplinary process, involving key groups affected by the recommendations.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

The authors of these guidelines, entitled *Guidelines for the Field Management of Combat-Related Head Trauma*, represented a multidisciplinary group consisting of neurosurgeons, trauma surgeons, neurointensivists, and paramedics from both the civilian and the military sectors. They were selected for their expertise in

traumatic brain injury (TBI), combat medicine, or military medical education. All the military authors had recent combat experience. Each author independently conducted a MEDLINE or comparable search, reviewed and evaluated the literature for their assigned topics, then cooperated in formulating the Guidelines during several work sessions aimed at completing understandable and applicable recommendations based on the best evidence available. The template for these Guidelines was the first edition of the *Guidelines for Prehospital Management of Traumatic Brain Injury* developed by Brain Trauma Foundation (BTF) in 1999–2000.

Section I of each chapter in the original guideline document describes the conclusions the authors formulated from the literature. For the chapters on assessment, which included prognosis studies, the authors summarized the evidence rather than made recommendations. Thus, their findings are listed as "Conclusions" for any diagnostic or prognostic assessment and as "Recommendations" where the end result is a specific treatment or set of treatment options. Section VII in each chapter provides a brief analysis of the literature that supports the conclusions or recommendations, whereas Section VIII references a more extensive list of studies.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Degrees of Certainty

Standards: Reflect a *high degree of clinical certainty* as indicated by the scientific evidence available (supported by Class I evidence).

Guidelines: Reflect a *moderate degree of clinical certainty* as indicated by the scientific evidence available (supported by Class II evidence).

Options: Reflect *unclear clinical certainty* as indicated by the scientific evidence available (supported by Class III evidence).

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

At several points during the development process, a review team comprised of representatives of the armed services medical "school houses," military neurosurgery and trauma surgery, and military medic instruction evaluated the document, and their comments were delivered to the authors. Several draft documents were produced and evaluated before this document was finalized and

published. (The names of the reviewers are listed at the front of the original guideline document.)

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

"Degrees of Certainty" (Standards, Guideline, Options) and "Classification of Evidence" (Class I to III) and the correlation between the two are defined at the end of the "Major Recommendations" field.

Recommendations

A. **Standards**

Data are insufficient to support a treatment standard for airway, ventilation, and oxygenation management techniques in the out-of-hospital or tactical environment.

B. **Guidelines**

Routine or prophylactic hyperventilation is not recommended and should be avoided.

C. **Options**

1. Airway management is crucial for the traumatic brain injury (TBI) patient and oxygen tension should be monitored and maintained at an oxygen saturation (SaO_2) $\geq$90. When the assessment indicates an obstructed airway, the management depends on the skills of the health care provider.
2. Adequacy of ventilation is measured by carbon dioxide partial pressure (pCO_2) or to a lesser degree of accuracy by end-tidal carbon dioxide ($EtCO_2$) measurement. Endotracheal intubation (ETI) by an experienced provider using direct laryngoscopy (DL) is accepted as the optimal method of airway control. There is evidence that the Intubating Laryngeal Mask Airway (ILMA®), the Combitube®, and the Fiberoptic Intubation device (FI) may be useful for the less experienced care giver.
3. While a chest radiograph is the traditional way to confirm endotracheal tube placement, there is evidence that the Self-Inflating Bulb (SIB) device and/or measurement of $EtCO_2$ (except in a cardiac arrest situation) are useful tools for confirming placement along with auscultation of the chest (when the environment would allow and when chest radiography is not an option).
4. Hyperventilation should only be done if patients are exhibiting signs of cerebral herniation such as posturing with asymmetric or bilateral dilated pupils. If done, hyperventilation is defined as 20 breaths per minute for adults. Hyperventilation should be discontinued as soon as signs of herniation normalize.

Summary

The assessment and treatment of airway, ventilation, and oxygenation problems must be interwoven step by step to successfully manage the TBI patient. Treatment of an obstructed airway must precede the assessment of ventilation. Similarly, the treatment of a patient who is not breathing must precede the assessment of circulation. This concept in the combat scenario is the same as in the civilian arena. Tactical and logistical considerations dominate the tools available to address these issues for the combat injured, with different provider skill levels and treatment capabilities existing at each level of care. Regardless of the level of care, every effort must be made to maintain the SaO_2 above 90% in suspected TBI patients. It is equally important to avoid hyper- and hypoventilation in these patients.

A patent airway should be assured and endotracheal intubation performed for patients with a Glasgow Coma Scale (GCS) <9 or for those who are unable to maintain or protect their airway. Evidence indicates that routine hyperventilation should not be performed. If ventilatory assistance after endotracheal intubation is provided, a respiratory rate of 10 breaths per minute should be maintained. After correction for hypoxemia or hypotension, if the patient shows obvious signs of cerebral herniation, such as extensor posturing and pupillary asymmetry or bilateral dilated pupils, the medical provider should hyperventilate the patient at a rate of 20 breaths per minute. This hyperventilation may be performed as a temporizing measure until the patient arrives at a medical facility when blood gas analysis will guide the ventilation rate. The guideline authors believe that end tidal CO_2 monitors or the use of the SIB tool will help avoid improper endotracheal tube placements. Further $EtCO_2$ monitors will help avoid hyper- or hypoventilation.

The airway/ventilation/oxygenation treatment training for military personnel (whether they be combat medics, paramedics, nurses, or physicians) should highlight TBI as a special consideration because of its long term impact on patient outcome. Evidence suggests that airway management skills decline early after initial training. Independent practice combined with periodic feedback should be encouraged. New and emerging simulation technologies show promise for practical skills training and education.

Definitions:

Classes of Evidence

Class I: Evidence from good quality randomized controlled trials (RCT)

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Class III: Evidence from moderate or poor quality cohort; or moderate or poor quality case-control; or case series, databases, or registries

Degrees of Certainty

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Options: Reflect *unclear clinical certainty* as indicated by the scientific evidence available (supported by Class III evidence).

CLINICAL ALGORITHM(S)

A clinical algorithm for "Field Management of Combat-Related Head Trauma" is provided in the original guideline document.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

An evidentiary table appears at the end of each major section of the guideline document, which classifies each citation based on the quality of the evidence (Class I-III; see "Major Recommendations" for definitions). The recommendations in this summary are supported by nine Class III studies and one Class II study.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate management of airway, ventilation, and oxygenation in combat-related head trauma

POTENTIAL HARMS

- The use of positive pressure ventilations with or without endotracheal intubation may be associated with adverse effects secondary to increased interthoracic pressures.
- Time to intubation, hypoxic events, and success of intubation were all compared with a fiberoptic intubation (FIB) group. The one important significant difference compared to using the Intubating Laryngeal Mask Airway (ILMA®) was a more frequent incidence of adverse events in the FIB group: 18% versus 0%, P <0.05.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- The information contained in the *Guidelines for the Field Management of Combat-Related Head Trauma*, which reflects the current state of knowledge at the time of completion (November 2005), is intended to provide accurate and authoritative information about the subject matter covered. Because there will be future developments in scientific information and technology, it is anticipated that there will be periodic review and updating of these Guidelines. These Guidelines are distributed with the understanding that the

Brain Trauma Foundation is not engaged in rendering professional medical services. If medical advice or assistance is required, the services of a competent physician should be sought. The recommendations contained in these Guidelines may not be appropriate for use in all circumstances. The decision to adopt a particular recommendation contained in these Guidelines must be based on the judgment of medical personnel, who take into consideration the facts and circumstances in each case and on the available resources.

- The majority of available recommendations are extrapolated from civilian data. In some instances, it will be obvious that the best civilian data have direct application to military scenarios. In others, it will be equally obvious that the best available civilian recommendation is impractical at best, and potentially threatening to life or mission accomplishment at worst. The guideline authors have attempted to discriminate between the two as often as possible, based on the available military-specific literature and personal experience. Ultimately, it will be the decision of the individual medic and/or the unit chain of command as to whether a particular diagnostic or therapeutic maneuver can be implemented. The general direction the authors have taken with their recommendations is that the best-known community standard should be implemented whenever possible.
- The recommendations in these guidelines are based on the best available data, and the authors maintained a patient-driven focus during development. In other words, each recommendation was created based upon the best care possible for the patient, in spite of the fact that tactical limitations may prevent this level of care from actually being available to all patients at all times. It should also be noted that guidelines such as these are quite different than protocols developed by medical facilities or military units. Protocols should be generated locally to give very specific directions as to how individual providers are to act in a variety of situations. Guidelines such as these are intended to serve as a starting point for the development of facility-specific protocols.
- Factors that create limitations in the level of medical care available in the combat environment include the overall tactical scenario, physiologic parameters associated with combat, and logistics. The guideline authors' ability to develop standards for optimal management is limited by a lack of scientific data. The majority of the recommendations provided are extrapolated from civilian data. While many of these recommendations will be both practical and applicable, the ability of the individual medic to provide this care may be limited.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Knuth T, Letarte PB, Ling G, Moores LE, Rhee P, Tauber D, Trask A. Guidelines for the field management of combat-related head trauma. Treatment: airway, ventilation, and oxygenation. New York (NY): Brain Trauma Foundation; 2005. 10 p. [26 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2005

GUIDELINE DEVELOPER(S)

Brain Trauma Foundation - Disease Specific Society

SOURCE(S) OF FUNDING

Brain Trauma Foundation

Uniformed Services University of the Health Sciences

GUIDELINE COMMITTEE

Not stated

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the Brain Trauma Foundation Web site.

Print copies: Available from the Brain Trauma Foundation, 708 Third Avenue, New York, NY 10017

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This NGC summary was completed by ECRI Institute on August 24, 2007. The information was verified by the guideline developer on January 28, 2008.

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